Claims

1. An all-optical regenerator, comprising:

an optical signal input node for receiving an input optical signal, the input optical signal including data; and

a regenerator waveguide receiving the input optical signal and an optical clock signal, and producing an output optical signal re-timed according to the optical clock signal and re-shaped according to the data in the input optical signal.

2. The all-optical regenerator of claim 1, wherein the regenerator waveguide provides amplification of the output optical signal relative to the input optical signal.

3. The all-optical regenerator of claim 2, wherein the regenerator waveguide employs temporal soliton interactions.

4. The all-optical regenerator of claim 3, wherein the temporal soliton interactions include cascaded quadratic non-linear solitons or saturating third-order non-linear solitons.

5. The all-optical regenerator of claim 1, further comprising:

a clock recovery unit for recovering timing information from the input optical signal; and

an optical clock generator to produce the optical clock signal synchronous with the timing information recovered by the clock recovery unit.

6. The all-optical regenerator of claim 5, wherein the optical clock generator includes a mode-locked laser, an optical delay line, an optical amplifier and an optical frequency doubler, cascaded in series, to generate the optical clock signal.

7. The all-optical regenerator of claim 5, further comprising:

a plurality of optical signal input nodes each for receiving a respective input optical signal at a respective wavelength; and

a plurality of regenerator waveguides each receiving a respective input optical signal and the optical clock signal, and producing a respective output optical signal at its respective wavelength re-timed according to the optical clock signal and re-shaped according to the data in its respective input optical signal, wherein the optical clock signal is synchronous with the timing information recovered from one of the input optical signals, and shared between the plurality of regenerator waveguides.

8. A method for all-optical regeneration, comprising:

receiving an input optical signal, the input optical signal including data;

receiving the input optical signal and an optical clock signal into a regenerator waveguide; and

producing an output optical signal re-timed according to the optical clock signal and re-shaped according to the data in the input optical signal.

9. The method of claim 8, wherein the regenerator waveguide provides amplification of the output optical signal relative to the input optical signal.

10. The method of claim 9, wherein the regenerator waveguide employs temporal soliton interactions.

11. The method of claim 10, wherein the temporal soliton interactions include cascaded quadratic non-linear solitons or saturating third-order non-linear solitons.

12. The method of claim 8, further comprising:

recovering timing information from the input optical signal; and

producing the optical clock signal synchronous with the timing information recovered by the clock recovery unit.

13. The method of claim 12, further comprising:

using a mode-locked laser, an optical delay line, an optical amplifier and an optical frequency doubler, cascaded in series, to generate the optical clock signal.

14. The method of claim 12, further comprising:

receiving a respective input optical signal at a respective wavelength at each of a plurality of optical signal input nodes; and

using a plurality of regenerator waveguides each receiving a respective input optical signal and the optical clock signal, and producing a respective output optical signal at its respective wavelength re-timed according to the optical clock signal and re-shaped according to the data in its respective input optical signal, wherein the optical clock signal is synchronous with the timing information recovered from one of the input optical signals, and shared between the plurality of regenerator waveguides.